for very accurate work. No mention, either, is made of any form of switch-board, such as that designed by Prof. S. P. Thompson, for the interchange of the coils when using Carey Foster's method of comparing resistances. A good description, accompanied by several excellent diagrams, is, however, given of Kelvin and Varley's slide, and of Kelvin's apparatus for the comparison of low resistances.

The remaining chapters are devoted to the measurement of high resistances, of batteries, and of electrolytes. There are six appendices, in which the mathematical theory of the Wheatstone's Bridge, Lord Kelvin's method of measuring low resistances, and Manse's method of measuring the resistance of a battery are given, together with discussions on the E.M.F. of contact at the junctions of a metre bridge, on the discharge of a condenser through a high resistance, and on the electrostatic analogue of a Wheatstone's Bridge.

The work would have been more useful if its scope had been enlarged, and if it had contained a detailed description of some complete set of instruments used in the comparison of standard resistances, such as are used by the British Association Committee on Electrical Standards at the Cavendish Laboratory. Nevertheless, it is a good book, written by one who is practically engaged in the manufacture and testing of these instruments, and who, not content with rules of thumb, gives the reason for each point involved in the design and construction.

There is no doubt the book will be found of great use in every laboratory and testing-room, and is, as the advertisers of patents are wont to say, "calculated to fill a long felt want." W. W.

AN ASTRONOMICAL ROMANCE.

A Journey in Other Worlds; a Romance of the Future. By John Jacob Astor. With ten Illustrations. Pp. 476. (London: Longmans, Green, and Co., 1894.)

SINCE Jules Verne wrote his "Journey from the Earth to the Moon," many writers have tried their hands at similar productions, but none have excelled their prototype. A good grasp of the principles of science, a vivid imagination, and a brilliant descriptive power, are essential faculties in the man who proposes to give the public a view of the future as seen through his prophetic eye. We do not think the author is blessed with a bountiful share of these qualifications; nevertheless, he has been able to bring forth a book in which instruction and entertainment are happily combined.

Looking forward to the epoch A.D. 2000, the author saw that many things had come to pass which are undreamt of in the philosophy of this enlightened century. The incidents of the story are centred round a scheme for changing the obliquity of the ecliptic, and a machine in which trips are taken to Jupiter and Saturn. It is a source of regret to many people, and especially to those who are doomed to linger in an erratic climate like ours, that the earth's axis is not perpendicular to the ecliptic. If such a condition of things existed at the present time, it could truly be said, "Blessed are they that inherit the earth." Every latitude would have its own almost uniform temperature all the year round, and the slight eccentricity of the earth's orbit would be sufficient to awaken recollections of the succession of the seasons. Life would indeed then be one perpetual spring.

The idea of decreasing the obliquity of the ecliptic is only an incidental part of Mr. Astor's story. The greater part of the book is taken up by an account of a journey to Jupiter and Saturn. But, before passing to this section, we must point out that a certain looseness of expression is manifest in the previous one. The project of changing the obliquity is constantly referred to as one of "straightening the terrestrial axis." The impression that the general reader will obtain from such an expression is that the earth's axis is only "straight" when it stands bolt upright, as it were, in the plane in which our globe revolves round the sun. How the author came to use the word "straight" in the sense which he does, passes our comprehension. Another and really less important matter, is that the earth's axis is said to be "inclined to the ecliptic about 23½ degrees." To be correct, the author should have said that the inclination to the ecliptic is 66½°, and that the angle between the axis and a perpendicular to the ecliptic is 23½°.

We come now to the flying machine. Jules Verne utilised known powers when he sent his imaginary car from the earth to our dreary satellite. Others who have followed in his wake have had to hypothecate their forces. *Apergy* is the force employed by Mr. Astor's characters. Similarly electrified bodies repel one another, argues he, then why may not matter exist in such a condition that gravitational attraction becomes apergetical repulsion? Given such a source of perpetual energy under control, and, heigh presto, away we can go into the realms of space, with concentrated extracts for food, and liquid oxygen for air supply. Three individuals undertook this kind of voyage in the year A.D. 2000; at least so the story goes. One is a learned bore who discourses sapiently on all and sundry circumstances of the journey. For instance, the information he hurls at his companions as Jupiter's largest satellite, Ganymede, is passed, is as follows. "This was discovered by Galileo in 1610. It is three thousand four hundred and eighty miles in diameter, while our moon is but two thousand one hundred and sixty, revolves at a distance of six hundred and seventy-eight thousand three hundred miles from Jupiter, completes its revolution in seven days and four hours, and has a specific gravity of 1·87."

This individual is brimful of knowledge which wells up at every opportunity, and, after a time, becomes very oppressive. His two companions, on the other hand, though assigned acute understandings and good educations by the author, listen in silence to these tiresome lectures on the most elementary facts of astronomy—an incongruity which is a very weak point in the story. Furthermore, the obtrusive dispenser of scientific scraps is much behind his time, for his astronomical knowledge does not go beyond that of the present day. If Mr. Astor were thoroughly conversant with astronomical investigations, he could have made his professor a much more interesting person. As it is, the man pours forth his spirit in and out of season, and is just the sort of individual that the majority of people are anxious to avoid.

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We will pass over the little incidents of the journey to Jupiter. Suffice it to say that Mars and his moons were observed, that a few asteroids were met and a comet penetrated, and eventually the Callisto—that was the name of the car—was landed on a hard part of the planet's surface. Jupiter was found to be in the Palæozoic period; and a smattering of geological knowledge has enabled the author to conjure up multitudes of "extinct monsters," which quite eclipse those in Mr. Hutchinson's book.

Having passed through Saturn's ring, and seen for themselves that it was composed of meteoritic particles, the party arrived safely on the planet. Our belted brother was found to be an abode of spirits, upon the characteristics of which we are not competent to express an opinion. The height of the ludicrous is reached at a dinner given to the travellers by one of these airy nothings, who, we are gravely told, "took only a slice of meat and a glass of claret." The idea of a diaphanous bishop consuming meat and claret is very rich.

A word or two on the general character of the book may not be out of place. The author rightly terms his production a romance—that is, a story hung upon seeming impossibilities. There is no plot, and the characters are merely mechanical puppets used to expound didactic ideas, so the book cannot be called a novel. It is, in fact, little more than a reading-book suitable for beginners in astronomy. We doubt whether many people will read it through without skipping the prosy parts, but they who conscientiously do so will undoubtedly acquire a certain amount of more or less useful knowledge. The author is usually accurate in his astronomy; and this, considering that writers of romances generally play fast and loose with astronomical phenomena, is saying a good deal. We commend the book to readers who like instructive tales.

R. A. GREGORY.

OUR BOOK SHELF.

Ueber die geometrischen Eigenschaften homogener starrer Structuren und ihre Anwendung auf Krystalle. Von W. Barlow. (Leipzig: Engelmann, 1894.)

THIS paper, which was recently published in the twenty-third volume of Groth's *Zeitschrift f. Krystallographie*, is an interesting contribution to the theory of crystal structure.

Mr. Barlow investigates the nature of a homogeneous structure, by which he means an arrangement of any material of constant form which is uniformly repeated throughout its whole extent. To every point in such a structure correspond other points homologous with it, and these must constitute one of the sixty-five regular assemblages of points as defined by Sohncke in his well-known treatise on crystal-structure. But the symmetry of the structure is not always identical with that of the assemblage of points derived from it, and it is sometimes necessary to extend the latter by a geometrical process of reflection or inversion in order to arrive at the symmetry of the structure. This process results in the addition of 164 possible homogeneous structures to the sixty-five already established. Incidentally it is shown that the assemblages of Sohncke are not in reality independent, but can all be regarded as compounded of one or other of ten assemblages belonging to the least symmetrical types in the various systems of crystallography. Fedorow and Schönflies have independently advanced a new theory, and agree in the result that there are 230 possible types of homogeneous structure. Since their methods are based upon Sohncke's definition extended by the principle of reflection or inversion, Mr. Barlow's investigation should lead to the same result. Now he finds 229 types, and expressly states that he is unable to account for a certain one of Fedorow's structures, so that his work is an absolute confirmation of the general accuracy of their calculations.

When this trifling question of 229 or 230 is settled, the problem of homogeneous structures, which was approached by Hauy 100 years ago, may be regarded as completely solved *from the purely geometrical point of view.*

Mr. Barlow's analysis of Sohncke's assemblages, and his laborious synthesis of the 164 new types, make the relations between the old and the new theory intelligible, and enable the reader to form a mental picture of all these complicated groupings: a task which is by no means easy from the writings of Fedorow and Schönflies without the aid of Mr. Barlow's tables.

H. A. M.

Theoretical Mechanics.—Solids. By Arthur Thornton M.A. Longmans' Advanced Science Manuals. (London: Longmans, Green, and Co., 1894.)

THE manuals published in this series are written specially to meet the requirements of the advanced stage of science subjects, and the present book will be found a very worthy addition. It is not surprising to hear, as the author tells us in the preface, that in preparing this work he was confronted by the syllabus of this department. The range which these 400 odd pages then cover, can on this account be at once gathered; and it can safely be stated that the book includes all that is generally necessary for any school course. The order in which the subject has been treated is first kinematics, in which the geometrical science of motion is dealt with, then statics, and finally kinetics, in which force is treated in its relation to motion. In each part the author feels himself by no means bound up as regards the choice of proofs and definitions; and he places before the reader, in a well-arranged series of paragraphs, all the theorems and problems, illustrating them when necessary with clear figures. The real essence of the subject, that is, the "book-work," has had special attention devoted to it, and each chapter contains a special number of problems to be deduced directly from it. Stress has been laid, too, on the importance of solving problems from first principles, and not from a direct substitution in formulæ. Formulæ can easily slip the memory, if not totally, then partially, and it is for this reason that numerous methods and samples of solution have been given.

Examples of all kinds, and especially those introducing great diversity of style, are scattered throughout the work, some being original, while others are obtained from numerous well-known sources. A useful appendix, containing a brief summary of trigonometrical formulæ, and a short index, brings the book to a conclusion. For the convenience of those who are preparing the subject for special examinations, a short list is given of the portions which may be omitted.

The Earth: an Introduction to the Study of Inorganic Nature. By Evan W. Small, M.A. University Extension Series. (London: Methuen and Co., 1894.)

IN this very acceptable addition to the well-known University Extension Series, we have a set of chapters which are not intended to form a text-book on physiography, but to serve as a book containing a certain amount of accurate and definite knowledge for the general reader. Such being the case, the author has not dealt fully with any of the various branches, but has treated, in a sketchy

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